

### **ABSTRACT OF THE DISCLOSURE**

[0045] The design and operation of a p-i-n device, operating in a sequential resonant tunneling condition for use as a photodetector and an optically pumped emitter, is disclosed. The device contains III-nitride multiple-quantum-well (MQW) layers grown between a III-nitride p - n junction. Transparent ohmic contacts are made on both p and n sides. The device operates under a certain electrical bias that makes the energy level of the first excitation state in each well layer correspond with the energy level of the ground state in the adjoining well layer. The device works as a high-efficiency and high-speed photodetector with photo-generated carriers transported through the active MQW region by sequential resonant tunneling. In a sequential resonant tunneling condition, the device also works as an optically pumped infrared emitter that emits infrared photons with energy equal to the energy difference between the first excitation state and the ground state in the MQWs.